

CLAIMS

What is claimed is:

1 1. A resonant tunneling diode comprising:

2 (a) a substrate of (100) GaAs;

3 (b) a multilayer resonant tunneling diode
4 structure grown on the (100) GaAs substrate, the resonant
5 tunneling diode structure comprising a quantum well layer
6 of low band-gap material between barrier layers of AlGaAs,
7 and wherein the material of the quantum well layer is
8 selected such that the second energy level of the quantum
9 well layer is at or slightly above the conduction band edge
10 in GaAs, the quantum well layer grown to be a strained
11 layer with smooth interfaces with the barrier layers.

1 2. The resonant tunneling diode device of Claim
1 1 wherein the quantum well layer comprises InGaAs.

1 3. The resonant tunneling diode device of Claim
2 2 wherein the barrier layers are composed of $Al_{0.8}Ga_{0.2}As$, and
3 the quantum well layer is formed of $In_{0.3}Ga_{0.7}As$.

1 4. The resonant tunneling diode device of Claim
2 3 wherein the barrier layers are about 14 \AA thick and the
3 quantum well layer is about 57 \AA thick.

1 5. The resonant tunneling diode device of Claim
2 2 including a spacer layer of intrinsic GaAs adjacent to
3 each barrier layer.

1 6. The resonant tunneling diode device of Claim
2 5 further including a layer of n-doped GaAs adjacent to
3 each GaAs intrinsic layer.

1 7. The resonant tunneling diode device of Claim
2 6 wherein the substrate is doped GaAs and the resonant

1 tunneling diode structure is isolated on a mesa with a
2 doped GaAs layer at the top of the mesa and further
3 including an insulating layer over the exposed surfaces of
4 the substrate and the mesa and a contact formed through the
5 insulating layer to the doped GaAs layer, and a contact on
6 the doped GaAs substrate opposite the mesa.

1 8. The resonant tunneling diode device of Claim
2 1 wherein the resonant tunneling diode structure is grown
3 on a nominally exact (100) +/- 0.5° GaAs substrate.

1 9. The resonant tunneling diode device of Claim
2 1 wherein the resonant tunneling diode structure is grown
3 on a nominally exact (100) +/- 0.1° GaAs substrate.

1 10. The resonant tunneling diode device of Claim
2 1 wherein the resonant tunneling diode structure is grown
3 on the GaAs substrate by metal organic chemical vapor
4 deposition.

1 11. A resonant tunneling diode comprising:

2 (a) a substrate of (100) GaAs;

3 (b) a multilayer resonant tunneling diode

4 structure grown on the (100) GaAs substrate, the resonant
5 tunneling diode structure comprising a quantum well layer
6 of InGaAs between barrier layers of AlGaAs, a spacer layer
7 of intrinsic GaAs adjacent to each barrier layer, and a
8 layer of n-doped GaAs adjacent to each GaAs intrinsic
9 layer, wherein the second energy level of the quantum well
10 layer is at or slightly above the conduction band edge in
11 GaAs, the quantum well layer grown by metal organic
12 chemical vapor deposition to be a strained layer with
13 smooth interfaces with the barrier layers.

1 12. The resonant tunneling diode device of Claim
2 11 wherein the barrier layers are composed of Al_{0.8}Ga_{0.2}As, and
3 the quantum well layer is formed of In_{0.3}Ga_{0.7}As.

1 13. The resonant tunneling diode device of Claim
2 12 wherein the barrier layers are about 14Å thick and the
3 quantum well layer is about 57Å thick.

1 14. The resonant tunneling diode device of Claim
2 11 wherein the substrate is doped GaAs and the resonant
3 tunneling diode structure is isolated on a mesa with a
4 doped GaAs layer at the top of the mesa and further
5 including an insulating layer over the exposed surfaces of
6 the substrate and the mesa and a contact formed through the
7 insulating layer to the doped GaAs layer and a contact on
8 the doped GaAs substrate opposite the mesa.

1 15. The resonant tunneling diode device of Claim
2 11 wherein the resonant tunneling diode structure is grown
3 on a nominally exact (100) +/- 0.5° GaAs substrate.

1 16. The resonant tunneling diode device of Claim
2 11 wherein the resonant tunneling diode structure is grown
3 on a nominally exact (100) +/- 0.1° GaAs doped substrate.

1 17. A method of making a resonant tunneling
2 diode comprising the steps of:

3 (a) providing a substrate of nominally exact
4 (100) GaAs;
5 (b) growing on the substrate by metal organic
6 chemical vapor deposition successive layers comprising at
7 least a barrier layer of AlGaAs, a strained quantum well
8 layer of low band-gap material, and a barrier layer of
9 AlGaAs, the quantum well layer grown with smooth interfaces
10 with the barrier layers with the second energy level of the
11 quantum well layer at or slightly above the conduction band
12 edge in GaAs.

1 18. The method of Claim 17 wherein the quantum
2 well layer material is InGaAs.

1 19. The method of Claim 15 wherein the barrier
2 layers are formed to be composed of $Al_{0.8}Ga_{0.2}As$, and the
3 quantum well layer is formed to be composed of $In_{0.3}Ga_{0.7}As$.

1 20. The method of Claim 17 further including
2 growing by metal organic chemical vapor deposition a spacer
3 layer of intrinsic GaAs adjacent to each barrier layer.

1 21. The method of Claim 20 further including
2 growing by metal organic chemical vapor deposition a layer
3 of n-doped GaAs adjacent to each GaAs intrinsic layer.

1 22. The method of Claim 21 wherein the substrate
2 is doped GaAs and including isolating the resonant
3 tunneling diode structure on a mesa with a doped GaAs layer
4 at the top of the mesa and further including forming an
5 insulating layer over the exposed surfaces of the substrate
6 and the mesa and forming a contact through the insulating
7 layer to the doped GaAs layer and forming a contact on the
8 doped GaAs substrate opposite the mesa.

1 23. The method of Claim 17 wherein the substrate
2 is nominally exact (100) $+/- 0.5^\circ$ GaAs.

1 24. The method of Claim 17 wherein the substrate
2 is nominally exact (100) $+/- 0.1^\circ$ GaAs.